LANDFILL GAS TRAINING

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ORIENTATION

INTRODUCTION

- **TYPE OF MONITORING**
  - **-Screening**
  - **-Specialized**
- **GOALS**

GOALS:

- **UNDERSTAND LFG BASICS**
- **UNDERSTAND LFG MONITORING SYSTEMS**

GOALS CONT.

- **UNDERSTAND LFG EQUIPMENT**
- **PRACTICE PROPER LFG MONITORING PROCEDURES**

COURSE OUTLINE

- **LANDFILL GAS BASICS**
- **MONITORING SYSTEM EVALUATION**
- **LFG SCREENING MONITORING**
- **INTRODUCTION TO LFG INSTRUMENTS**

COURSE OUTLINE CONT.

- **INSTRUMENT OPERATION PROCEDURES**
- **LUNCH**
- **FIELD EXERCISE**
- **DISCUSSION OF FIELD RESULTS**

COURSE OUTLINE CONT.

- **QUESTIONS & COMMENTS**
- **EXAM**

LANDFILL GAS BASICS

Landfill Gas (LFG)

- **Gaseous emissions produced as a by-product of organic waste during decomposition.**

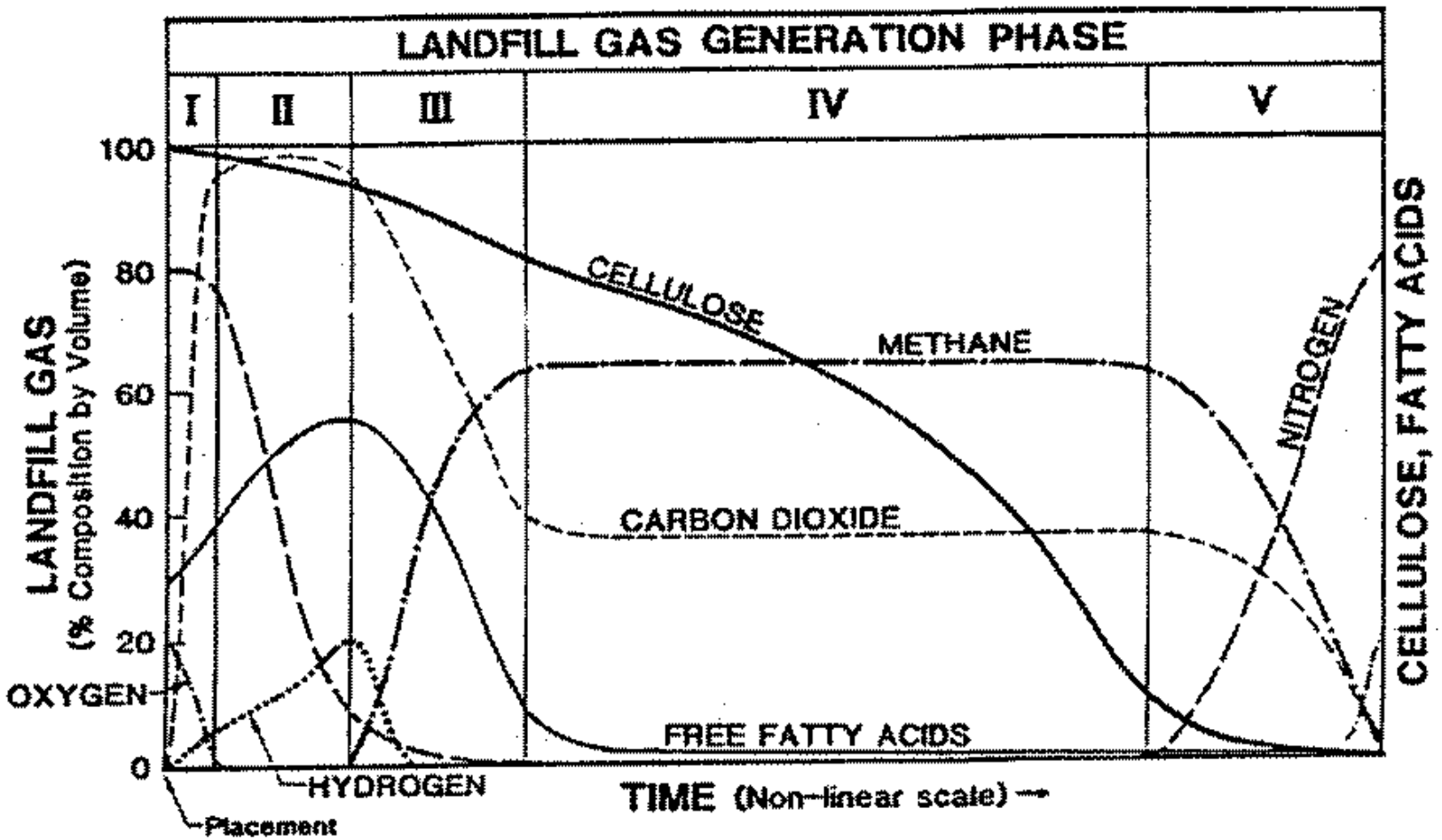
- **May contain various chemical components in widely fluctuating quantities.**

ANAEROBIC REACTION

Anaerobic Bact.

$$(C_6H_{10}0_5)_n + nH_20 \longrightarrow 3nCH_4 + 3nC0_2$$

TYPICAL LANDFILL GAS GENERATION PATTERN



SOURCE: Farquar and Rovers, 1973, as modified by Rees, 1980, and Augenstein & Pacey, 1991

Figure 2. Typical landfill gas generation pattern

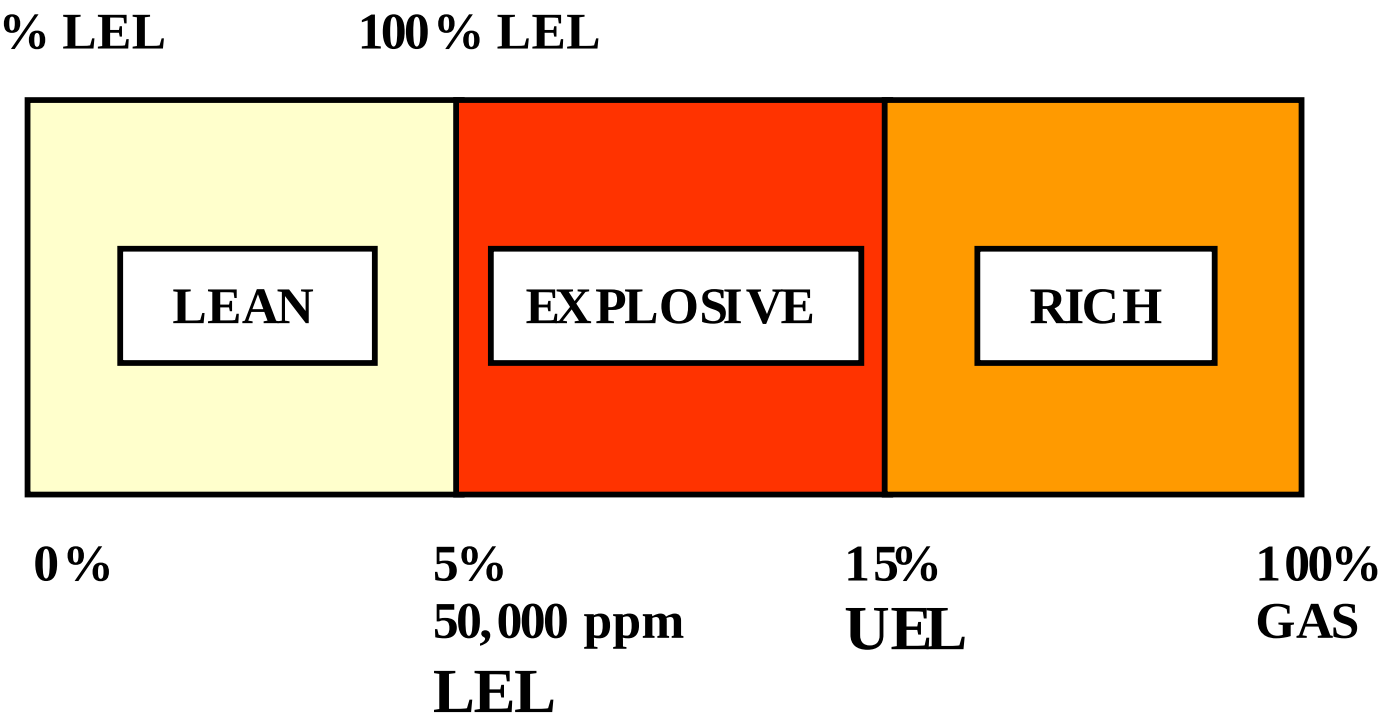
LANDFILL DECOMPOSITION GAS

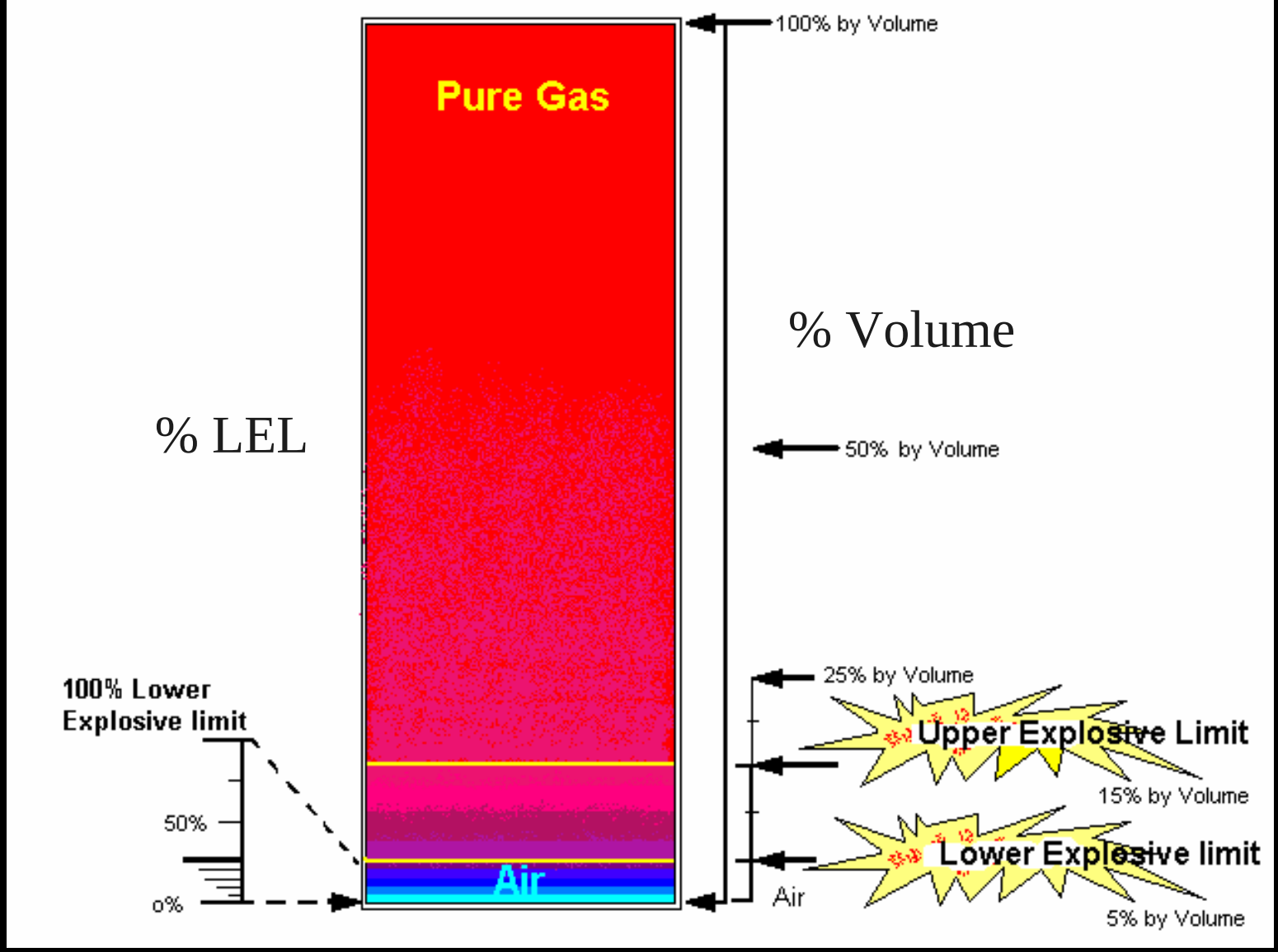
- **METHANE CH4**
  - **SIMPLE ASPHYXIANT**
  - **HIGH FIRE HAZARD**
  - **HIGH EXPLOSION HAZARD**
  - **LIGHTER THAN AIR**

Basic Conversions

- **5% Methane in air = 50,000 PPM**
- **1.25% Methane in air = 12,500 PPM**
- **100% of the Lower Explosive Limit (LEL)= 5% Methane in Air**
- **25% of the LEL=1.25% Methane in Air**

METHANE FLAMMABILITY RANGE

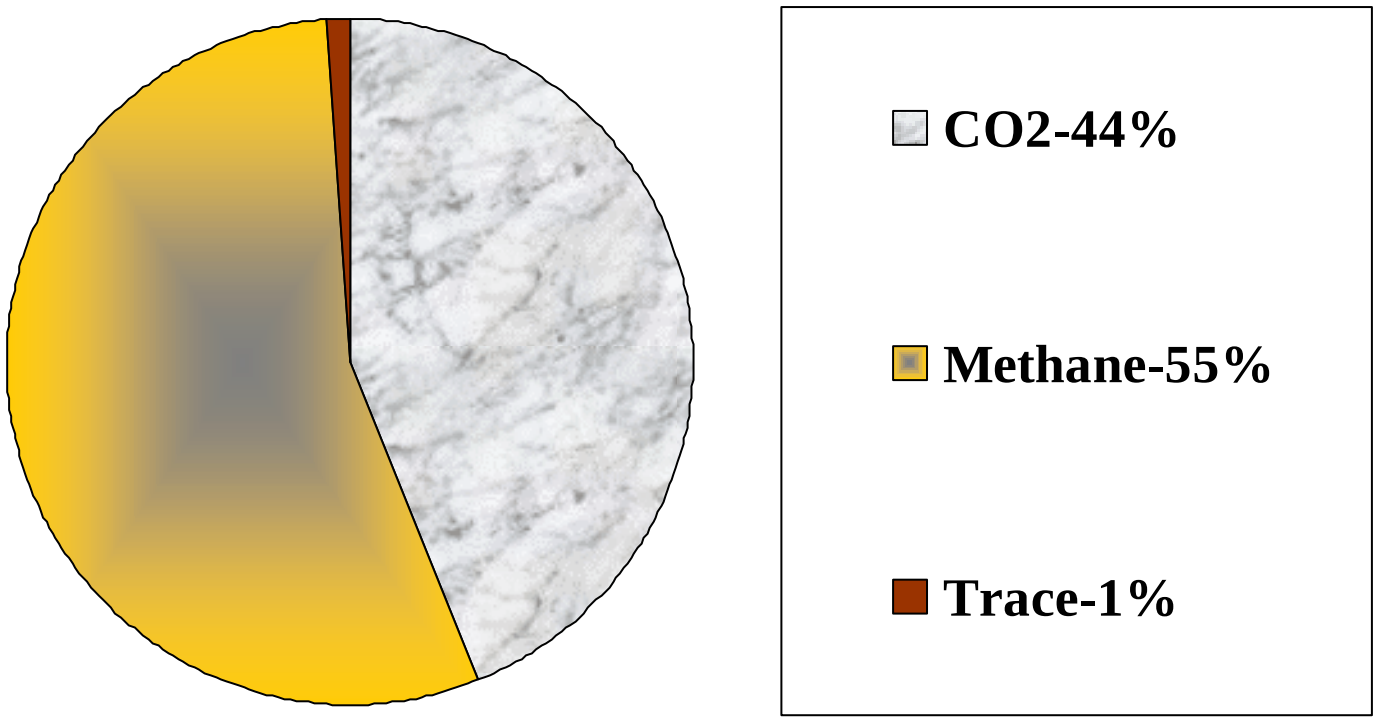




LEL=5% Gas by Volume=50,000 ppm

UEL=15% Gas by Volume=150,000 ppm

COMPOSITION OF LFG



LANDFILL GAS (LFG) CONT.

- **Up to 60% Methane (CH_4) by volume,**

- **Variable amounts of:**

  -water vapor,

  -carbon dioxide (CO_2),

  -hydrogen sulfide (H_2S),

  -carbon monoxide (CO)

LANDFILL GAS (LFG) CONT.

Trace contaminants, including but not limited to:

- Benzene
- Ethyl Benzene
- Toluene
- Vinyl Chloride
- Dichloromethane
- Trichloroethylene (TCE)
- 1,2, Dichloroethylene
- Tetrachloroethylene(PCE)

TYPICAL TRACE GASES

	Hydrogen Sulfide	H2S
	Ammonia	NH3
VOCs	Vinyl Chloride	C2H3CL
	Benzene	C6H6
	Methylene Chloride	CH2CL2
	Trichloroethylene	C2HCL3

LANDFILL GAS (LFG) CONT.

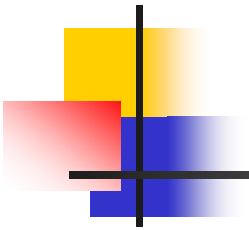
Each of the components, including the trace compounds, may or may not be found together either at concentrated subsurface sources or as dilute zones within ambient air.

Theoretically any combination or permutation of components is possible

LANDFILL GAS (LFG) CONT.

The potential for detecting the trace components in ambient air without substantial concentrations of methane or hydrogen sulfide gas as a carrier at other than a concentrated emission source, however, has been shown to be very low.


QUESTIONS



MONITORING SYSTEM EVALUATION

INFORMATION GATHERING

- **Review previous LFG inspection reports**
- **Identify specific probes to be sampled**
- **Obtain monitoring system maps & as-built drawings**
- **Check probe depths & location with respect to extraction wells**

INFORMATION GATHERING

- **Review LFG monitoring probe design**
- **Consider type, quantity & depth of waste**
- **Consider proximity of receptors**
- **Make sure all probes are functional**

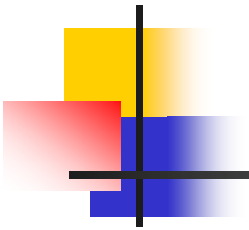
INFORMATION GATHERING

Determine if probes are properly placed

- **At (within 2 feet) the permitted (property boundary)**
- **At a point of compliance**
- **At a point approx. midway between LFG control wells**
- **At a proper spacing & depth**
- **Adjacent to critical receptors**


QUESTIONS

BREAK



LFG SCREENING MONITORING

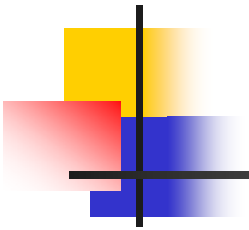
Basic Conversions

- 5% Methane in air = 50,000 PPM

  Remember that 1% = 10,000 ppm
- 1.25% Methane in air = 12,500 PPM
- 100% of the Lower Explosive Limit (LEL)= 5% Methane in Air
- 25% of the LEL=1.25% Methane in Air

ACRONYMS AND SYMBOLS CONT.

- PPM - PARTS PER MILLION
- % O_2 - PERCENT OXYGEN
- CO - CARBON MONOXIDE
- H_2S - HYDROGEN SULFIDE
- LEL - LOWER EXPLOSIVE LIMIT
- UEL - UPPER EXPLOSIVE LIMIT



INTRODUCTION TO LFG INSTRUMENTS

1-PPM, % Methane, LEL, UEL
2-Probe Construction
3-Probe Location
4-Are there adequate # of probes installed?
5-Location of extraction wells in relation to monitoring probe locations.
6-Gas movement from the site
7-Any question in regards to LFG.

SENSORY THEORY

- CATALYTIC - PPM AND 0 TO 10% GAS (O_2 DEPENDENT TO 2%)
- THERMAL - 10% TO 100% GAS BY VOLUME (NON O_2 DEPENDENT)
- CHEMICAL - O_2, H_2S, CO

GMI INSIDE CASE

GMI AND SAMPLING COMPONENTS

GMI BODY AND BATTERY

PROBE AND COMPONENTS

GMI IN COMBUSTIBLE GAS INDICATOR MODE USES AND FEATURES

- COMBUSTIBLE PPM RANGE
- NO AUDIBLE OR VISUAL ALARMS
- MANUAL DATA LOGGING ONLY
- MANUAL RANGE VIEWING WITHOUT AUTOMATIC HAZARD OVERRIDE

GMI IN COMBUSTIBLE GAS INDICATOR MODE USES AND FEATURES CONT.

- MEASURES CO AND H2S, PPM RANGES
- HEALTH& SAFETY AND REGULATORY SCREENING TOOL
- **NOT TO BE USED IN LIEU OF LAB ANALYSIS**

USING THE GMI IN COMBUSTIBLE GAS INDICATOR MODE (CGIM)

- Press SECOND button ONCE* to turn on
- Press second button ONCE to change range
- Press second button TWICE to re-zero ppm range
- Press third button to take samples
- Press top/first button twice to turn off

* ONE SECOND OR MORE

CGI Mode-Ranges

- % GAS BY VOLUME
- TOTAL COMBUSTIBLE GAS IN PPM
- % OXYGEN BY VOLUME
- PPM CARBON MONOXIDE (CO)
- PPM HYDROGEN SULFIDE (H2S)

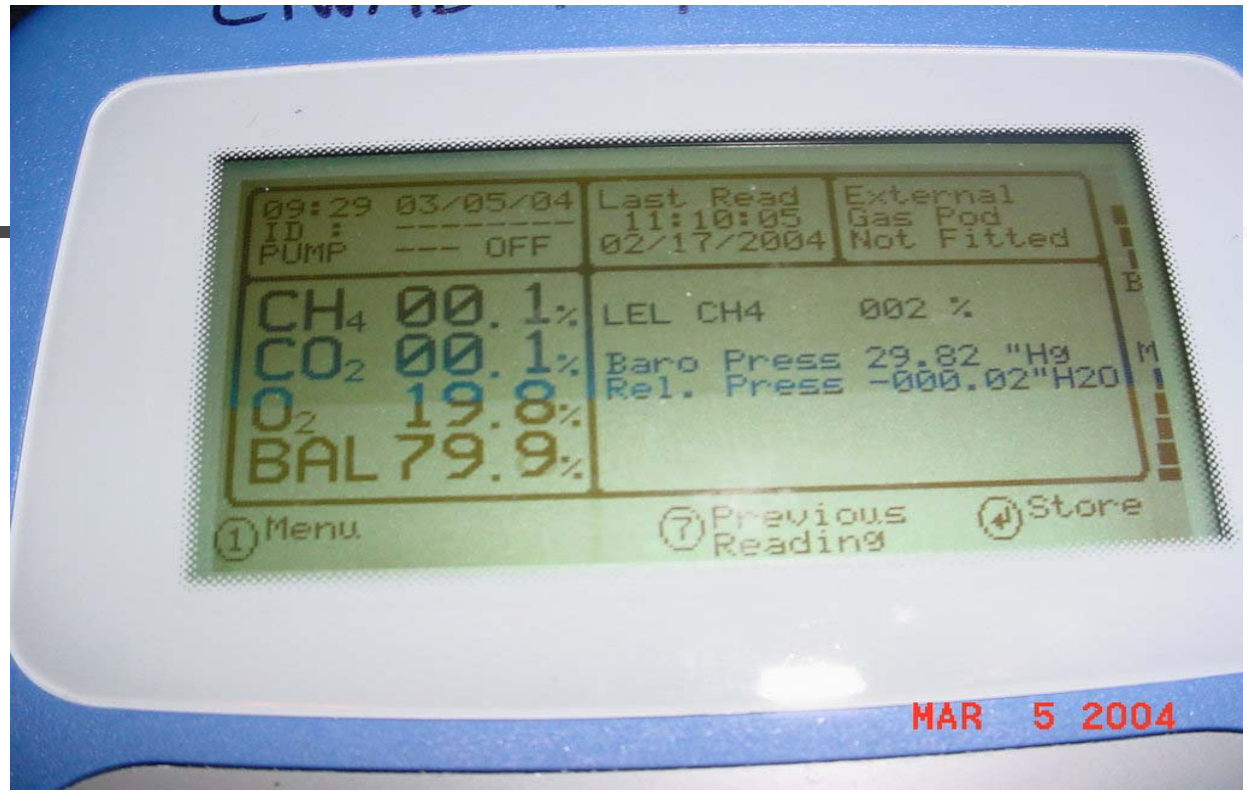
THEN BACK TO

- % GAS BY VOLUME

GEM CASE


CIWMB
Gem 2000
4
S/N 07033
PELICAN 1500 CASE
PELICAN PRODUCTS TORRANCE, CA USA
MAR 5 2004

GEM FACE PANEL



GEM CONTROL PANEL

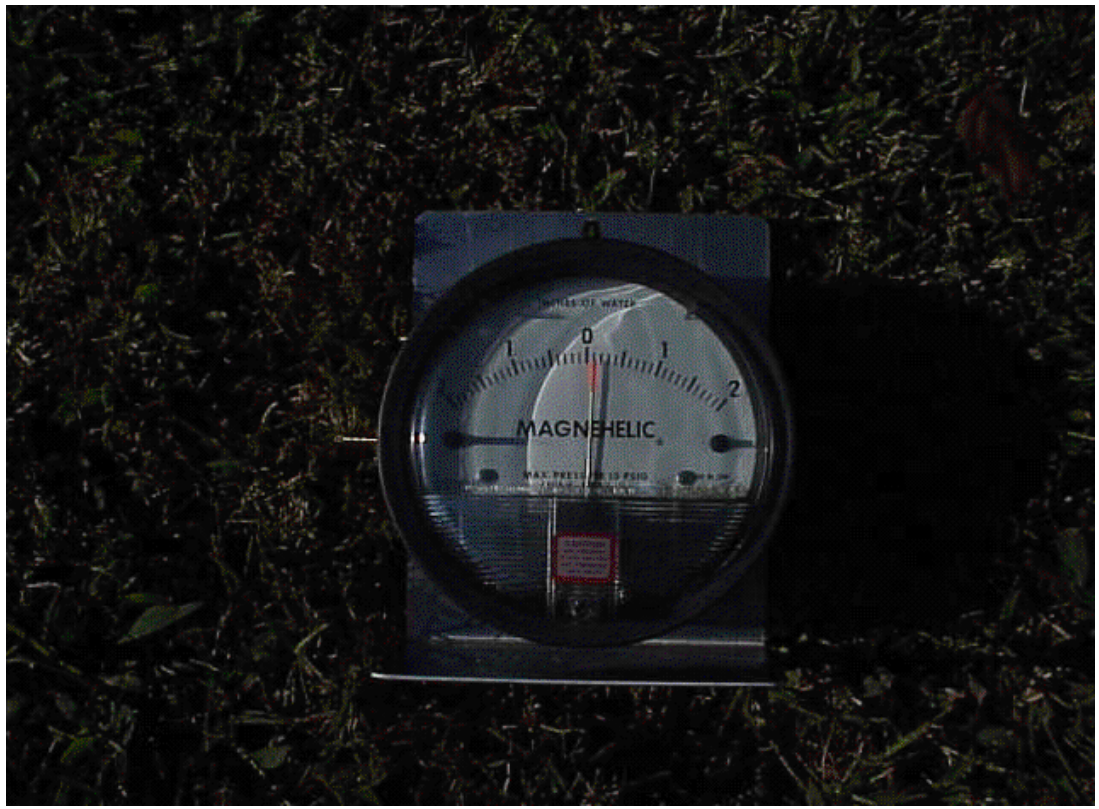
GEM COMPONENTS

GEM COMPONENTS

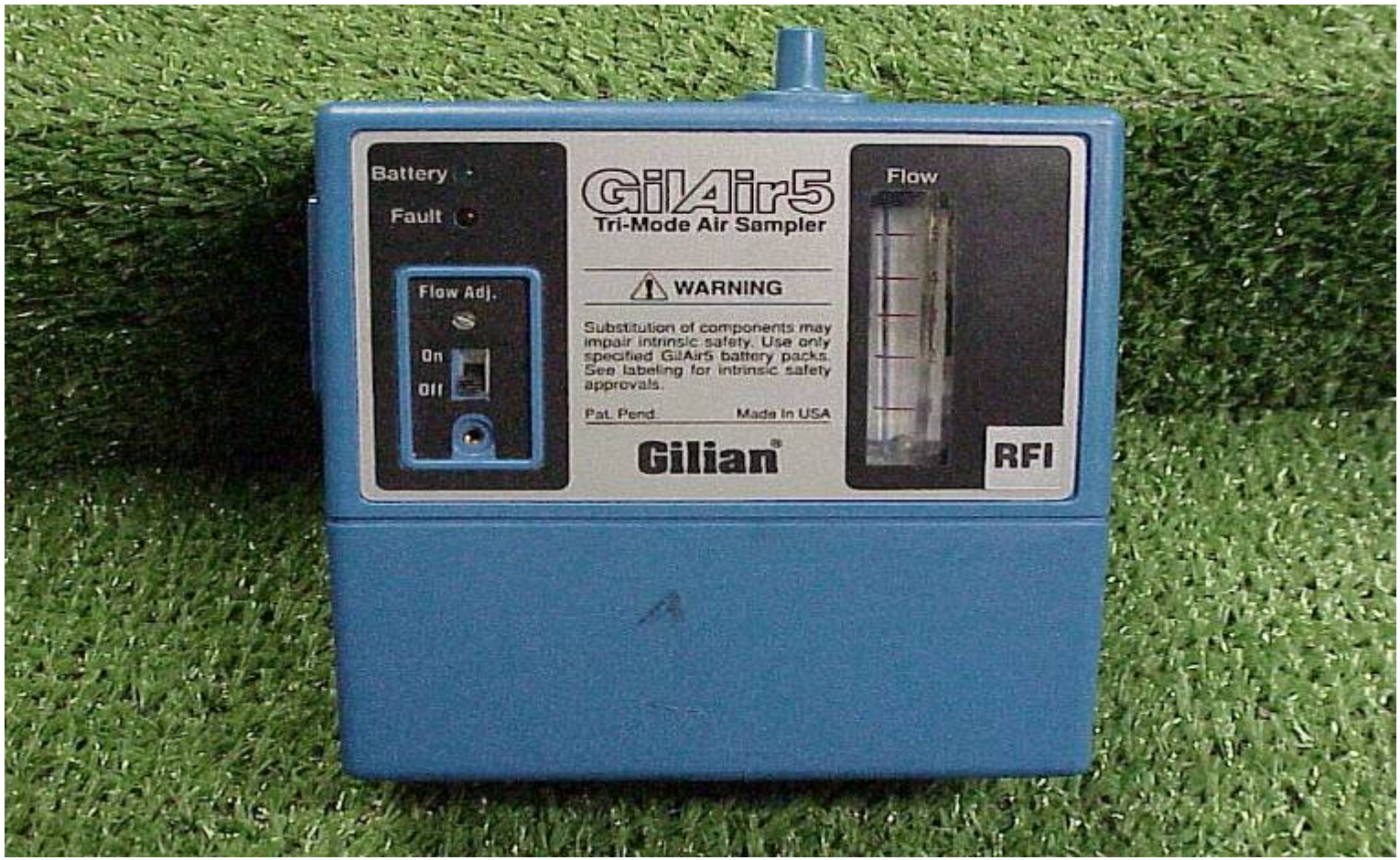
GAS SAMPLING EQUIPMENT

- MAGNAHELICS
- EVAC/TRANSFER PUMP
- TEDLAR BAGS
- TUBING AND CONNECTORS

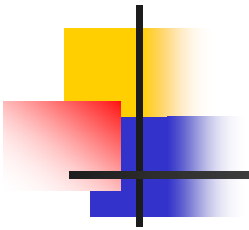
MAGNEHELIC



EVAC/TRANSFER PUMP




QUESTIONS



LUNCH